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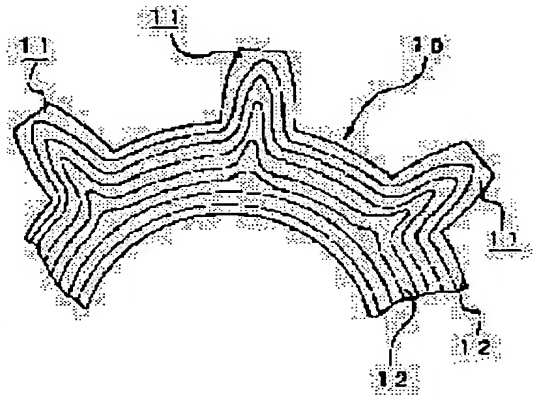
(54) RESIN GEAR AND MANUFACTURE THEREOF

(57)Abstract:
PROBLEM TO BE SOLVED: To provide a resin gear, the manufacturing of which is easy and which is lightweight and excellent in mechanical strength and wear resistance, and its manufacturing method.
SOLUTION: A sheet 12, which is mainly made of a hardening resin and reinforcing fibers through a paper-making method, is wound like the growth ring of a three into a prepreg. The obtained prepreg is filled in a mold so as to form under heat and pressure in order to manufacture a resin gear as its is without cutting, or by cutting and then polishing, when necessary. In the obtained resin gear 10, the sheet 12 formed by paper-making method, of which each tooth consists, is arranged like the growth ring to the tree. In addition, by the manufacturing of this resin gear, action effects such as the simple and sure manufacturing of these gears and the low cost provision of them are taken even when the gear is an internal tooth resin gear or an external tooth resin gear and its tooth is a spur gear tooth or a helical gear tooth.



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* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

CLAIMS

[Claim(s)]
[Claim 1] Resin gear to which said paper-milling sheet which is the resin gear which twist and carry out a part of prepreg which rolls the paper-milling sheet which uses thermosetting resin and reinforcement fiber as a principal component, and is obtained, presuppose all, and come to carry out heating pressing of this, and constitutes the gear tooth of these resin gear is characterized by being arranged in the shape of annual rings.

[Claim 2] Resin gear according to claim 1 characterized by said thermosetting resin being resin which is represented by phenol resin, an epoxy resin, and diallyl phthalate resin, and in which moisture powder is possible in said resin gear.
[Claim 3] Resin gear according to claim 1 or 2 characterized by containing further carbon powder, carbon fiber, fluororesin powder, a fluororesin chip, or the potassium titanate whiskers in said paper-milling sheet as a slipping agent in said resin gear.
[Claim 4] said resin gear -- setting -- the gear tooth of these resin gear -- a lotus -- the resin gear according to claim 1 to 3 characterized by being a gear tooth.
[Claim 5] Resin gear according to claim 1 to 4 to which the gear tooth of these resin gear is characterized by being an internal tooth in said resin gear.
[Claim 6] Resin gear according to claim 1 to 4 characterized by winding said paper-milling sheet around the core material in said resin gear.
[Claim 7] Resin gear according to claim 6 characterized by making said core material in said resin gear using the paper-milling sheet with which the contents of the class of said thermosetting resin, said thermosetting resin, or said reinforcement fiber differ.
[Claim 8] The paper-milling sheet which uses hardenability resin and reinforcement fiber as a principal component is rolled in the shape of annual rings. Prepreg and nothing, It is the manufacture approach of the resin gear which insert in and carry out heating pressing of the obtained prepreg to metal mold. The process which fabricates the prepreg which has the part which winds pressing with the press roller which has the press gear tooth of the dimension configuration which asks for the A aforementioned paper-milling sheet, and serves as an external tooth of said resin gear, Press processing is carried out with the press roller which has the press gear tooth of the dimension configuration which asks for the external surface of the prepreg which finishes come to wind the I aforementioned paper-milling sheet. By this Forcible press fit is carried out into the die which has the press gear tooth formed in the predetermined dimension configuration of asking for the process which fabricates the part used as the external tooth of said resin gear, and the prepreg which finishes come to wind the U aforementioned paper-milling sheet to an internal surface. By this The manufacture approach of the resin gear which contain whether it is the process and ******** which fabricate the part used as the external tooth of said resin gear, and are characterized by being constituted.
[Claim 9] The paper-milling sheet which uses hardenability resin and reinforcement fiber as a principal component is rolled in the shape of annual rings. Prepreg and nothing, It is the manufacture approach of the resin gear which insert in and carry out heating pressing of the obtained prepreg to metal mold. To the shaping heart which has the press gear tooth of the dimension configuration which asks for the E aforementioned paper-milling sheet The process which fabricates the prepreg which has the part which winds pressing with a press roller and serves as an internal tooth of said resin gear, Forcible press fit of the die which has the press gear tooth formed at the predetermined dimension configuration for which it asks to a skin into the prepreg of the hollow which finishes come to wind the O aforementioned paper-milling sheet is carried out. By this The manufacture approach of the resin gear which contain whether it is the process and ******** which fabricate the part used as the internal tooth of said resin gear, and are characterized by being constituted.

[Claim 10] The manufacture approach of the resin gear according to claim 8 or 9 characterized by said thermosetting resin being resin which is represented by phenol resin, an epoxy resin, and diallyl phthalate resin, and in which moisture powder is possible in the manufacture approach of said resin gear.
[Claim 11] The manufacture approach of the resin gear according to claim 8 to 10 characterized by containing further carbon powder, carbon fiber, fluororesin powder, a fluororesin chip, or the potassium titanate whiskers in said paper-milling sheet as a slipping agent in the manufacture approach of said resin gear.
[Claim 12] The manufacture approach of claims 8 and 10 characterized by winding said paper-milling sheet around the core material in the manufacture approach of said resin gear, or resin gear given in either of 11.
[Claim 13] The manufacture approach of the resin gear according to claim 12 characterized by making said core material in the manufacture approach of said resin gear using the paper-milling sheet with which the contents of the class of said thermosetting resin, said thermosetting resin, or said reinforcement fiber differ.
[Claim 14] the manufacture approach of said resin gear — setting — the gear tooth of these resin gear — a lotus — the resin gear according to claim 8 to 13 characterized by being a gear tooth.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to resin gear and its manufacture approach.
[0002]
[Description of the Prior Art] Resin gear are used in order [before] to prevent the noise generated from the conduction gear by high-speed operation of various machine tools and an industrial machine, and the machine structure or oil pollution with difficult supply of a lubricating oil.
[0003] As resin gear which the former requires, phenol resin and reinforcement fiber, such as a glass fiber and an aramid fiber, Sinking-in desiccation of the phenol resin varnish is carried out at the base material of the shape of a sheet, such as what obtained the molding material which carried out mixed kneading and made carbon powder granular, carried out injection molding of this molding material, and was formed in the predetermined configuration, and asbestos paper. The prepreg which made the infiltrated thermosetting resin the semi-hardening condition (B stage) is made. It is processed by piercing this prepreg in piles so that it may become predetermined thickness. Distribute these in liquid by using as an indispensable component the thing which carried out gear-cutting processing after carrying out heating pressing and thermosetting resin powder and reinforcement fiber, and carbon powder, and paper is milled. The things (JP,7-20681,B, JP,5-78500,A, etc.) which used the paper-milling sheet obtained as the multilayer sheet-like molding material in piles so that it might become predetermined thickness, and carried out gear-cutting processing after piercing and processing this and carrying out heating pressing (direct pressure shaping) subsequently are well-known.
[0004]
[Problem(s) to be Solved by the Invention] However, since reinforcement fiber broke, or it went out and became short when according to the approach of carrying out [above-mentioned] injection molding and manufacturing the gear of a predetermined configuration carrying out mixed kneading of the reinforcement fiber with phenol resin and considering as a molding material, there was a problem [mold goods / with reinforcement as expected at the beginning] of being difficult to get. Furthermore, since reinforcement fiber was cut at the gate of the screw metallurgy mold of the cylinder of a making machine when performing injection molding, there was a problem that a strong fall became large. And by the gear which carried out injection molding, there were also problems — reinforcement falls and it is easy to be divided — in the part which weld tended to generate when reinforcement fiber carries out orientation, and directivity will be made to the reinforcement of mold goods or it fabricates, and weld generated.
[0005] If it was in the gear which carried out gear cutting of it after carrying out heating pressing of the prepreg which made thermosetting resin the semi-hardening condition (B stage) subsequently by processing it by piercing in piles so that it may become predetermined thickness, he wanted to add for example, carbon powder to a resin varnish, and to, perform sinking in to a sheet-like base material on the other hand, but since carbon powder did not distribute to a resin varnish at homogeneity, were able to add carbon powder and it was not able to be manufactured.
[0006] Moreover, tension was applied to the sheet-like base material at the process which carries out sinking-in desiccation and transports phenol resin varnish to a long sheet-like base material, and since it was fabricating while this tension had remained in prepreg as distortion, the problem of being easy to generate deformation of curvature and torsion was in the fabricated gear. Moreover, although reinforcement was held, since the slipping agent like carbon powder was not added, there was a problem that sliding nature was bad.
[0007] if a paper-milling sheet is used as a multilayer sheet-like molding material in piles further again so that it may become predetermined thickness, and this molding material is pierced and processed (the so-called blanking processing), these activities are very troublesome and that workability is bad — in addition, there were many losses of a multilayer sheet-like molding material, and in order to lose this futility, there was a

problem that the activity which generally re-mills paper was needed.
[0008] and after carrying out heating pressing, coefficient of linear expansion is large, and hygroscopicity is also high, and maintenance of dimensional accuracy is difficult for them again while each gear which come to carry out gear cutting are inferior in thermal resistance or mechanical strength — etc. — there was a problem.
[0009] Manufacture is easy, and the place which this invention is wholeheartedly originated in view of such the actual condition, and is made into the purpose offers the resin gear which made it lightweight and were excellent in mechanical strength and abrasion resistance, and its manufacture approach, and uses many above-stated problems as a dissolution plug.
[0010] By fabricating the prepreg which has a part equivalent to an internal tooth, and performing heating pressing processing to this, the place made into other purposes of this invention can manufacture internal-tooth resin gear easily, and makes this an offer plug at a low price.
[0011]
[Means for Solving the Problem] Therefore, the place made into the summary of the means which this invention adopted is as given in an above-stated claim.
[0012] According to the resin gear of this invention which adopted such a configuration, since it is manufactured by inserting in metal mold a part thru/or all of prepreg that rolled round thermosetting resin and the paper-milling sheet containing reinforcement fiber, and formed the gear tooth in the peripheral face, and carrying out heating pressing to a predetermined configuration, a mass production of said prepreg is attained and improvement in productivity can be aimed at. Moreover, a paper-milling sheet can be created separately, and can be kept, this can be fabricated to prepreg if needed, and a production adjustment of final product slack resin gear becomes very easy.
[0013] Moreover, since tension does not work to the conventional sheet-like base material like [in the case of carrying out sinking-in desiccation of the resin varnish] and distortion does not remain in the obtained molding material, and since it does not break with external force like [in case reinforcement fiber is the conventional mixed kneading], early fiber length can be made to hold as it is. that is, it will become a cause that reinforcement fiber is cut, and a strong fall will become large, or reinforcement fiber will carry out orientation like injection molding, and directivity will be made to the reinforcement of mold goods, or weld occurs, and reinforcement tends to fall and break — ** — many problems which the resin gear which ** etc. and the former require possess are solvable.
[0014] Moreover, orientation can be changed into the condition of having made all the paper-milling sheets that constitute a gear tooth following radial [of the gear concerned], there is little deformation of curvature, torsion, etc., there is no strong directivity, and it can provide as resin gear with a high precision.
[0015] Since blanking waste is not generated further again unlike the case where said molding material is pierced, processed and used, it is not necessary to be immersed into liquid, to unfold blanking waste and to mill paper again like before. That is, the troublesome activity which starts while being able to use a molding material without futility can be excluded, reduction of a labor cost and improvement in productivity can be aimed at, and it can provide at a low price.
[0016] the operation which resin gear according to claim 1 to 2 possess especially since the slipping agent (a sliding agent, sliding agent) is contained in the paper-milling sheet as a principal component with resin gear **** according to claim 3 — in addition, it becomes the resin gear which have the outstanding sliding nature and sliding nature.
[0017] Moreover, since the configuration which winds the paper-milling sheet with which the contents of the class of thermosetting resin, thermosetting resin, or reinforcement fiber differ around the configuration which winds a paper-milling sheet around resin gear **** according to claim 6 to 7 and the core material made from steel materials, or the core material made of synthetic resin is adopted, in addition to the operation which resin gear according to claim 1 to 3 possess, it becomes resin gear with the multilayer structure from which mechanical strength etc. differs further.
[0018] The troublesome activity which thermosetting resin and the paper-milling sheet containing reinforcement fiber roll according to the manufacture approach of the resin gear of this invention which adopted such a configuration next, obtains the prepreg which has a part used as the gear tooth of final-product slack resin gear, the so-called back process which fabricates and carries out gear cutting of the resin plate like before becomes unnecessary since it is constituted so that heating pressing of these part thru/or all may be inserted in and carried out to metal mold, and starts can exclude. That is, while a mass production of prepreg is possible and being able to aim at improvement in the productivity, reduction of a labor cost can be aimed at and, moreover, resin gear with a high precision can be manufactured at a low price.
[0019] Moreover, a paper-milling sheet can be created separately, and can be kept and this can be fabricated

to the prepreg concerned if needed. That is, a production adjustment becomes possible.
[0020] And since blanking waste is not generated again unlike the case where said molding material is pierced, processed and used, it is not necessary to be immersed into liquid, to unfold blanking waste and to mill paper again like before, and a molding material can be used without futility.
[0021] Tension does not work to a sheet-like base material further again like [in the case of carrying out sinking-in desiccation of the resin varnish], and distortion does not remain in the obtained molding material. Moreover, since it does not break with external force like [in case reinforcement fiber is the conventional mixed kneading], early fiber length can be maintained almost as it is. namely, — if the reinforcement in the part which weld generated that it is easy to generate weld falls and it is easy to be divided, in case a strong fall will become large, or reinforcement fiber will carry out orientation like injection molding, and directivity will be made to the reinforcement of mold goods or it fabricates, since reinforcement fiber is cut — etc. — many problems which the conventional manufacture approach possesses are solvable.
[0022] If it is in the manufacture approach according to claim 9 which adopted such a configuration especially, operation that it can manufacture simply [the resin gear which have an internal tooth], and certainly is acquired.
[0023] If it is in the manufacture approach according to claim 10 which adopted such a configuration, since a harmful organic solvent is not used in addition to the operation which the manufacture approach of above-stated resin gear possesses, a paper-milling sheet and operation that resin gear can be safely manufactured if it pulls are acquired.
[0024] If it is in the manufacture approach according to claim 11 which adopted such a configuration, since the slipping agent (a sliding agent, sliding agent) is contained in the paper-milling sheet, operation that resin gear equipped with the gear tooth excellent in sliding nature or sliding nature can be manufactured in addition to an above-stated operation is acquired.
[0025] If it is in the manufacture approach according to claim 12 or 13 which adopted such a configuration for example, the configuration which winds a paper-milling sheet around the core material made from steel materials — or Since the configuration of rolling a paper-milling sheet is adopted, the paper-milling sheet with which the contents of the class of resin, thermosetting resin, or reinforcement fiber differ in the core material made of resin Operation that the resin gear which have the multilayer structure from which reinforcement etc. differs especially can manufacture simply and certainly in addition to an above-stated operation is acquired.
[0026]
[Embodiment of the Invention] Hereafter, it explains to a detail based on the example which materialized this invention.
[0027] In enforcing the approach concerning this invention, especially if a solvent can be distributed, it is not limited, but since water can be used for thermosetting resin as a solvent when milling a paper-milling sheet as it is thermosetting resin like phenol resin, an epoxy resin, or diallyl phthalate resin which can be distributed to water, it is suitable. In addition, if the case where phenol resin is used as thermosetting resin is made into an example and it explains, 1-30 micrometers is suitable for the particle size of the powder. Moreover, since there is a problem in the safety of an organic solvent etc., I want to avoid if possible, although a paper-milling sheet may be milled as a solvent using an organic solvent.
[0028] As reinforcement fiber, a glass fiber, glass powder, an aramid fiber, aramid pulp, etc. can be illustrated, and it is used as these independence or two or more sorts of mixture.
[0029] When using for example, carbon powder as a slipping agent, 1-50 micrometers is suitable for the particle size of carbon powder, but especially if it can be made to distribute when milling paper, it will not limit. Moreover, it may replace with carbon powder, other slipping agents like carbon fiber, fluororesin powder, and a fluororesin chip may be used, and other fillers and additives may be suitably blended on the occasion of paper milling.
[0030] Drawing 1 is a flow chart which shows the manufacture approach of the resin gear of the first example, drawing 2 is the part plan of the resin gear manufactured by this manufacture approach, and the orientation of the paper-milling sheet 12 in the part of the gear tooth 11 of the final product slack resin gear 10 is shown especially typically.
[0031] First, phenol resin powder (particle size of 1-20 micrometers) and an aramid fiber (5-20 micrometers of diameters) Make water distribute the fiber length of 2-6mm at 35/65 of a rate by the weight ratio, mill this, and it considers as the paper-milling sheet A. As it considers as the barrel 14 which has the predetermined thickness for which it asks while rolling round on a core material 13 immediately and is further shown on this barrel 14 at drawing 3 Pressing with the press roller 16 which has press gear-tooth 16a formed in the predetermined dimension configuration corresponding to the part used as the gear tooth 11 of the final

product slack resin gear 10, said paper-milling sheet A is twisted and prepreg 15 is fabricated.
[0032] Next, this prepreg 15 is moved in the metal mold of predetermined size, subsequently to a room temperature, after returning, the cutter cut, when still more nearly required, the whole front face was ground, heating pressing (direct pressure shaping) was performed for 10 minutes at 200 degrees C with the condition of having pressed by the pressure of 700kg/cm2 or more to the longitudinal direction, and the final product slack resin gear 10 were obtained. The property of these resin gear 10 is shown in Table 1.
[0033] In addition, the paper-milling sheet 12 which twists on said barrel 14 and is carried out is phenol resin powder (particle size of 1-20 micrometers), and an aramid fiber (5-20 micrometers of diameters). water being made to distribute the fiber length of 2-6mm, and carbon powder (particle size of 1-20 micrometers) at a rate of 35/55/10 by the weight ratio, and that it is the paper-milling sheet B which comes to mill paper this Since carbon powder functions as a slipping agent and resin gear equipped with the gear tooth which was excellent with sliding nature and sliding nature can be manufactured, it is desirable.
[0034] Next, the manufacture approach of the resin gear 20 of the second example The paper-milling sheet B is not twisted pressing to drawing 4 , with the press roller 16 which has press gear-tooth 16a on said barrel 14, as a flow chart shows. As typically shown in drawing 5 after that which rolled said paper-milling sheet B on the barrel 14 which rolled and fabricated said paper-milling sheet A, and fabricated predetermined barrel 14' Except for the point which fabricates prepreg 15, others serve as the manufacture approach of the first example from the same process substantially by pressing the peripheral face of this barrel 14' by press gear-tooth 16a with which this press roller 16 was equipped while rotating the press roller 16.
[0035] The resin gear 20 which have the same dimension configuration as the resin gear manufactured by the manufacture approach of the first example by the manufacture approach of this second example were obtained. The property of these resin gear 20 is shown in Table 1.
[0036] In addition, for a start, before carrying out heating pressing (direct pressure shaping) of said barrel 14 (14') in the manufacture approach of the resin gear of the second example, a cutter etc. cuts said prepreg 15, resin gear prepreg 15' of given thickness is formed, heating pressing (direct pressure shaping) of this resin gear prepreg 15' is carried out, as long as it is required, the whole front face may be ground and final product slack resin gear may be manufactured.
[0037] Thus, for a start which was constituted, since it is the configuration that roll round the paper-milling sheet 12 immediately, consider as prepreg 15, and heating pressing of those part thru/or all is carried out according to the manufacture approach of the resin gear of the second example, if this prepreg 15 can be produced continuously and pulled, improvement in this resin gear productive efficiency can be aimed at.
[0038] Moreover, tension does not work to a sheet-like base material like [in the case of carrying out sinking-in desiccation of the resin varnish], and distortion does not remain in the obtained prepreg. Moreover, the many problems which the reinforcement of the part which weld's generated the fall of the reinforcement by cutting of reinforcement fiber since reinforcement fiber is maintaining early fiber length almost as it is becoming large, or reinforcement fiber carrying out orientation like injection molding, and directivity being made to the reinforcement of mold goods, or it being easy to generate weld falling, and it being easy to be divided, etc. and the conventional manufacture approach possess are solvable.
[0039] moreover, an abbreviation of the paper-milling sheet 12 centering on the core of resin gear — orientation can be carried out to spiral or concentric circular. That is, since reinforcement does not fall in the part which weld could not generate easily and weld generated while being able to make homogeneity contain all the reinforcement fiber contained in resin gear, for example, and being hard to generate deformation of curvature and torsion and losing strong directivity and deformation, it is hard to be divided.
[0040] And since blanking waste is not generated again unlike the case where said molding material is pierced, processed and used, it is not necessary to be immersed into liquid, to unfold blanking waste and to mill paper again like before. That is, the starting troublesome activity can be excluded, reduction of a labor cost can be aimed at, and while being able to use a molding material without futility, improvement in productivity can be aimed at.
[0041] When heating pressing of the prepreg fabricated further again from the paper-milling sheet which uses thermosetting resin, reinforcement fiber, and carbon powder as a principal component is carried out, while a degree of hardness is high and excelling in a mechanical strength, it can manufacture simple [the resin gear which were exceptionally excellent in sliding nature or sliding nature], and certainly.
[0042] The manufacture approach of the resin gear 30 of the third example made water distribute phenol resin powder (particle size of 1-20 micrometers), and an aramid fiber (the path of 5-20 micrometers, fiber length of 2-6mm) at 35/65 of a rate by the weight ratio, milled this, made it the paper-milling sheet A, dried this paper-milling sheet A, and removed moisture. In addition, this desiccation was performed in the temperature requirement (ordinary temperature) to which the hardening reaction of phenol resin does not go.

Subsequently, it rolled round on the core material, pressing the paper-milling sheet A from which moisture was removed by press gear-tooth 16a with which the press roller 16 was equipped, and the core material was sampled, prepreg 15 was obtained, and the following performed the same post processing as the manufacture approach of the first example. Thus, the resin gear 30 which have the same dimension configuration as the resin gear 10 manufactured by the manufacture approach of the first example of the above were obtained. The property of these resin gear is shown in Table 1.

[0043] The operation effectiveness which the resin gear 30 manufactured by the manufacture approach of the third example and this manufacture approach possess In the operation effectiveness which the resin gear 10 manufactured by the manufacture approach of said first example 1 and this manufacture approach possess, in addition, since the shape of a paper-milling sheet can be created separately, and can be kept, this can be rolled round if needed and prepreg can be fabricated, While becoming convenient to manufacture of a small lot, the outstanding operation effectiveness that a production adjustment becomes very easy is acquired.

[0044] Mixed kneading of conventional example 1 phenol resin and the glass fiber (the path of 9 micrometers, fiber length of 1-2mm) was carried out by 45/55 of the blending ratio of coal by the weight ratio, and it considered as the granular molding material. The resin gear which have the same dimension configuration as the resin gear which carried out injection molding of this and were manufactured by the manufacture approach of the first example were obtained. The property of these resin gear is shown in Table 1.

[0045] Water is made to distribute conventional example 2 phenol resin and an aramid fiber (the path of 5-20 micrometers, fiber length of 3mm) at 45/55 of a rate by the weight ratio. This is milled, it considers as a paper-milling sheet, and the prepreg which has the predetermined thickness for which it asks while rolling round on a core material immediately is fabricated. Subsequently This prepreg was moved in the metal mold of predetermined size, and with the condition of having pressed by the pressure of 700kg/cm2 or more to the longitudinal direction, heating pressing (direct pressure shaping) was performed for 10 minutes at 200 degrees C, and it returned to the room temperature. After the cutter cut to radial, gear-cutting processing was carried out, and the resin gear which have the same dimension configuration as the resin gear manufactured by the manufacture approach of the first example of the above were obtained. The property of these resin gear is shown in Table 1.

[0046]

table 1 [ ] Deddendum reinforcement Flexural strength The amount of deflections (kgf) (kgf/mm2) (mm/100kgf) The conventional example 1 137 17.0 0.28 Conventional example 2 230 25.0 0.52 213 24.8 0.49 205 25.3 The 0.51 first example 395 40.5 0.49 The second example 370 36.5 0.55 The third example 385 38.9 0.48 [0047] By the way, the resin gear created by the manufacture approach of the resin gear of each example and this manufacture approach which were mentioned above In stating as a typical embodiment of this invention, not limiting this invention to said example and carrying out this invention It is the range which does not deviate from the meaning of this invention. For example, the whole resin gear configuration, or it carries out the design change of the blending ratio of coal etc. to classes, such as a dental dimension configuration, thermosetting resin, and strengthening fiber, or manufactures eccentric type resin gear — a dental configuration — not a spur tooth but a lotus — or it fabricates for a gear tooth — ** — a design change is carried out suitably and it can carry out.

[0048] said paper-milling sheet 12 was rolled and the predetermined barrel 14 (14') was fabricated, as typically shown in drawing 6 after that In the die 17 which has press gear-tooth 17a formed in the predetermined dimension configuration for which it asks to an internal surface Forcible press fit is carried out without rotating both, rotating either this die 17 or the barrel 14 (14') at a predetermined rate. By this A process may be given after obtaining the prepreg 15 (15') which has a part used as the gear tooth 11 (external tooth 41) of said resin gear, carrying out heating pressing of this, and mentioning above.

[0049] As typically shown in drawing 7 , to moreover, the shaping heart 18 which has press gear-tooth 18a of a dimension configuration which asks for said paper-milling sheet 12 The prepreg 45 which has the section is obtained. while carrying out forcible press with the press roller 16 which has press gear-tooth 16a — winding — the gear tooth 11 (internal tooth 42) of the resin gear 40 concerned — As typically shown in drawing 8 , in centrum 14a of the hollow barrel 14 (14') which finishes rolling the paper-milling sheet 12 and becomes Forcible press fit is carried out without rotating both, rotating either this die 19 or the barrel 14 (14') for the die 19 which has press gear-tooth 19a formed in the predetermined dimension configuration for which it asks to a skin at a predetermined rate. By this If heating pressing of this is carried out and post processing is performed if needed after obtaining the prepreg 55 which has a part used as the gear tooth 11 (internal tooth 42) of the resin gear 50 concerned, the resin gear 40 and 50 equipped with the internal tooth 42 can be manufactured. Especially the mode of this operation corresponds to invention according to claim 9.

[0050] in addition — if forcible press fit is carried out in these manufacture approaches, rotating either said

die or said barrel at a predetermined rate, and it is sampled and carried out, making it rotate subsequently — an external tooth — a lotus — it becomes a gear tooth. Forcible press fit is carried out without rotating both a die and a barrel, and if it is sampled as it is without making it rotate subsequently, an external tooth will turn into a spur tooth. Especially the mode of this operation corresponds to invention according to claim 14.
[0051]
[Effect of the Invention] an abbreviation of the paper-milling sheet with which each manufacture approach of the resin gear which become this invention constitutes these resin gear as stated above centering on the abbreviation core of the resin gear concerned, while being arranged spirally or in the shape of an approximately concentric circle Since it has the configuration description at the place where the paper-milling sheet is arranged in the shape of annual rings also in the gear tooth of resin gear, according to the resin gear manufactured by this manufacture approach, the outstanding operation effectiveness taken below is acquired.

[0052] (1) Prepreg is made by rolling up of a paper-milling sheet. Therefore, since tension is not working to a sheet-like base material like [in the case of carrying out sinking-in desiccation of the resin varnish], distortion does not remain in the obtained prepreg. And since the fiber length of reinforcement fiber has also held the die length of here, this prepreg is extremely excellent in dimensional accuracy. Moreover, in the part which the fall of the reinforcement by cutting of reinforcement fiber will become large, or reinforcement fiber will carry out orientation like injection molding, and directivity will be made to the reinforcement of mold goods, or weld tended to generate, and weld generated, if reinforcement falls and it is easy to be divided, many problems of all that the conventional manufacture approach whether it is possesses are solvable.
[0053] (2) In the condition [having maintained early fiber length almost as it is], said paper-milling sheet can manufacture the resin gear equipped with the gear tooth which has the reinforcement which whose deformation of final product slack resin gear was small, and was excellent since it was able to be made to arrange in the shape of annual rings also in the part of the gear tooth of resin gear especially, and distortion did not remain in prepreg, and can offer them.
[0054] (3) Since blanking waste next is not generated unlike the conventional technique which pierces, processes and uses a molding material, it is not necessary to be immersed into liquid, to unfold blanking waste and to mill paper again. Therefore, since improvement in productivity can be aimed at while being able to exclude the starting troublesome activity and being able to aim at reduction of a labor cost, reduction of the manufacturing cost of resin gear can be aimed at, and this can be offered at a low price.
[0055] (4) When said paper-milling sheet is milled considering thermosetting resin and reinforcement fiber as a principal component, a degree of hardness is high, and resin gear excellent in the mechanical strength can be manufactured simple and certainly, and can be offered. And since the slipping agent is contained when used for the part from which thermosetting resin, reinforcement fiber, and the slipping agent like carbon powder are milled as a principal component, and said paper-milling sheet constitutes the gear tooth of resin gear, resin gear excellent in sliding nature and sliding nature can be manufactured simple and certainly, and can be offered.
[0056] (5) Especially, according to the manufacture approach of resin gear according to claim 9, "the prepreg which has a part used as an internal tooth" which was not able to be fabricated easily until now can be fabricated simply and certainly, and heating pressing can be carried out to "internal-tooth resin gear." namely, an internal tooth — a spur tooth — it is — a lotus — a gear tooth — it is — being alike — not related, these can be manufactured certainly and can be offered at a low price.

[Translation done.]

* NOTICES *

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] Drawing 1 is a flow chart which shows the manufacture approach of the resin gear of the first example roughly.
[Drawing 2] Drawing 2 is the part plan of the 1 resin gear which become this invention, and the orientation of the paper-milling sheet in the periphery of an external tooth is shown especially typically.
[Drawing 3] Drawing 3 is the perspective view showing typically signs that the paper-milling sheet is rolled, pressing by the press gear which have the press gear tooth formed in the predetermined dimension configuration corresponding to the part used as the gear tooth of final product slack resin gear (void arrow head).
[Drawing 4] Drawing 4 is a flow chart which shows the manufacture approach of the resin gear of the second example roughly.
[Drawing 5] Drawing 5 is the perspective view showing typically signs that press the peripheral face of a barrel for this press gear tooth, and prepreg is fabricated, rotating the press gear which have a press gear tooth.
[Drawing 6] Drawing 6 is a front view which carries out forcible press fit into the die which has the press gear tooth formed in the predetermined dimension configuration of asking for the barrel which comes to wind a paper-milling sheet to an internal surface and which this shows typically [in order to explain signs that the prepreg which has a part used as the external tooth of said resin gear is fabricated]. However, only the die is shown by the sectional view.
[Drawing 7] drawing 7 is typically shown, in order to explain signs that the prepreg which has the part which winds pressing a paper-milling sheet with a press roller to the shaping heart which has a press gear tooth, and serves as an internal tooth of the resin gear concerned is fabricated — it is a fracture perspective view a part.
[Drawing 8] Drawing 8 is a front view shown typically, in order to explain signs that the prepreg which has the part which carries out forcible press fit of the die which has a press gear tooth in a skin, and serves as an internal tooth of the resin gear concerned into the barrel of the hollow which finishes come to wind a paper-milling sheet is fabricated. However, the frame part of a die is shown by the sectional view.
[Description of Notations]
10 — Resin gear
11 — Gear tooth
12 — Paper-milling sheet
13 — Core material
14 — Barrel
14' — Barrel
14a — Centrum
15 — Prepreg
15' — Resin gear prepreg
16 — Press roller
16a — Press gear tooth
17 — Die
17a — Press gear tooth
18 — Shaping heart
18a — Press gear tooth
19 — Die
19a — Press gear tooth

20 — Resin gear
30 — Resin gear
40 — Resin gear
41 — External tooth
42 — Internal tooth
45 — Prepreg
50 — Resin gear
55 — Prepreg

[Translation done.]

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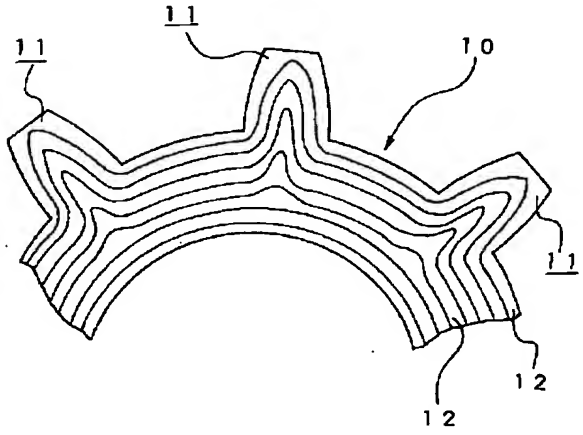
(54)【発明の名称】　樹脂ギヤー及びその製造方法

(57)【要約】
【課題】　製造が容易で、軽量にして且つ機械強度及び耐摩耗性に優れた樹脂ギヤーとその製造方法を提供すること。
【解決手段】　硬化性樹脂と補強繊維とを主成分とする抄造シート１２を年輪状に巻いてブリプレグとなし、得られたブリプレグを金型に填めて加熱加圧成形した後、切断しないでそのまま又は切断し必要であればさらに研磨する樹脂ギヤー１０の製造方法であり、得られた樹脂ギヤー１０は、各歯１１を構成する前記抄造シート１２が年輪状に配置されるところにその構造特徴がある。
又、この樹脂ギヤー１０の製造方法によれば、内歯樹脂ギヤーであっても外歯樹脂ギヤーであっても、そして歯１１が平歯形状であってもハス歯形状であってもこれらを簡単且つ確実に製造でき、これを廉価に提供できる、という作用効果を奏するものである。



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【特許請求の範囲】

【請求項１】　熱硬化性樹脂と補強繊維とを主成分とする抄造シートを巻いて得られるブリプレグを一部ないし全部としてこれを加熱加圧成形してなる樹脂ギヤーであって、

該樹脂ギヤーの歯を構成する前記抄造シートが、年輪状に配置されていることを特徴とする樹脂ギヤー。

【請求項２】　前記樹脂ギヤーにおいて、

前記熱硬化性樹脂が、フェノール樹脂、エポキシ樹脂、ジアリルフタレート樹脂に代表される水分散可能な樹脂であることを特徴とする請求項１に記載の樹脂ギヤー。

【請求項３】　前記樹脂ギヤーにおいて、

前記抄造シートに、カーボン粉末、カーボン繊維、ふっ素樹脂粉末、ふっ素樹脂チップ、又はチタン酸カリウムウイスカのうちのいずれかが、滑り剤としてさらに含まれていることを特徴とする請求項１又は２に記載の樹脂ギヤー。

【請求項４】　前記樹脂ギヤーにおいて、

該樹脂ギヤーの歯が、ハス歯であることを特徴とする請求項１～３のいずれかに記載の樹脂ギヤー。

【請求項５】　前記樹脂ギヤーにおいて、

該樹脂ギヤーの歯が、内歯であることを特徴とする請求項１～４のいずれかに記載の樹脂ギヤー。

【請求項６】　前記樹脂ギヤーにおいて、

前記抄造シートが、芯材に巻かれていることを特徴とする請求項１～４のいずれかに記載の樹脂ギヤー。

【請求項７】　前記樹脂ギヤーにおいて、

前記芯材が、前記熱硬化性樹脂の種類、又は前記熱硬化性樹脂若しくは前記補強繊維の含有量が異なる抄造シートを使用して作られたものであることを特徴とする請求項６に記載の樹脂ギヤー。

【請求項８】　硬化性樹脂と補強繊維とを主成分とする抄造シートを年輪状に巻いてブリプレグとなし、得られたブリプレグを金型に填めて加熱加圧成形する樹脂ギヤーの製造方法であって、

ア）前記抄造シートを、所望する寸法形状の押圧歯を有する押圧ローラで押圧しながら巻いて前記樹脂ギヤーの外歯となる部分を有するブリプレグを成形する工程、

イ）前記抄造シートを巻き終えてなるブリプレグの外面を、所望する寸法形状の押圧歯を有する押圧ローラで押圧処理し、これにより、前記樹脂ギヤーの外歯となる部分を成形する工程、

ウ）前記抄造シートを巻き終えてなるブリプレグを、内壁面に所望する所定の寸法形状に形成された押圧歯を有する成形型の中に強制圧入し、これにより、前記樹脂ギヤーの外歯となる部分を成形する工程、

のいずれかを含み構成されていることを特徴とする樹脂ギヤーの製造方法。

【請求項９】硬化性樹脂と補強繊維とを主成分とする抄造シートを年輪状に巻いてブリプレグとなし、得られたブリプレグを金型に填めて加熱加圧成形する樹脂ギヤーの製造方法であって、

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エ）前記抄造シートを、所望する寸法形状の押圧歯を有する成形芯に、押圧ローラで押圧しながら巻いて、前記樹脂ギヤーの内歯となる部分を有するブリプレグを成形する工程、

オ）前記抄造シートを巻き終えてなる中空のブリプレグの中に、外壁面に所望する所定の寸法形状に形成された押圧歯を有する成形型を強制圧入し、これにより、前記樹脂ギヤーの内歯となる部分を成形する工程、

のいずれかを含み構成されていることを特徴とする樹脂ギヤーの製造方法。

【請求項１０】　前記樹脂ギヤーの製造方法において、前記熱硬化性樹脂が、フェノール樹脂、エポキシ樹脂、ジアリルフタレート樹脂に代表される水分散可能な樹脂であることを特徴とする請求項８又は９に記載の樹脂ギヤーの製造方法。

【請求項１１】　前記樹脂ギヤーの製造方法において、前記抄造シートに、カーボン粉末、カーボン繊維、ふっ素樹脂粉末、ふっ素樹脂チップ、又はチタン酸カリウムウイスカのうちのいずれかが、滑り剤としてさらに含まれていることを特徴とする請求項８～１０のいずれかに記載の樹脂ギヤーの製造方法。

【請求項１２】　前記樹脂ギヤーの製造方法において、前記抄造シートが、芯材に巻かれていることを特徴とする請求項８、１０、又は１１のいずれかに記載の樹脂ギヤーの製造方法。

【請求項１３】　前記樹脂ギヤーの製造方法において、前記芯材が、前記熱硬化性樹脂の種類、又は前記熱硬化性樹脂若しくは前記補強繊維の含有量が異なる抄造シートを使用して作られたものであることを特徴とする請求項１２に記載の樹脂ギヤーの製造方法。

【請求項１４】　前記樹脂ギヤーの製造方法において、該樹脂ギヤーの歯が、ハス歯であることを特徴とする請求項８～１３のいずれかに記載の樹脂ギヤー。

【発明の詳細な説明】

【０００１】

【発明の属する技術分野】本発明は、樹脂ギヤー及びその製造方法に関するものである。

【０００２】

【従来の技術】従来より、各種工作機械や産業機械の高速運転による伝導ギヤーより発生する騒音や、潤滑油の供給困難な機械構造又は油汚染を防止する目的で、樹脂ギヤーが使用されている。

【０００３】従来のかかる樹脂ギヤーとしては、フェノール樹脂と、ガラス繊維、アラミド繊維等の補強繊維と、カーボン粉末とを混合混練して粒状にした成形材料を得、この成形材料を射出成形して所定形状に形成したもの、アスベスト紙等のシート状の基材にフェノール樹脂ワニスを含浸乾燥して、含浸させた熱硬化性樹脂を半

硬化状態（Ｂステージ）としたプリプレグを作り、このプリプレグを所定の厚さになるように重ねて打ち抜き加工を施し、加熱加圧成形した後に歯切り処理したもの、及び熱硬化性樹脂粉末と補強繊維とカーボン粉末を必須成分としてこれらを液中に分散させて抄造し、得られる抄造シートを所定の厚さになるように重ねて多層シート状の成形材料とし、これを打ち抜き加工し、ついで、加熱加圧成形（直圧成形）した後に歯切り処理したもの（特公平７－２０６８１号公報、特開平５－７８５００号公報等）が、公知である。

【０００４】

【発明が解決しようとする課題】しかしながら、上記射出成形して所定形状のギヤーを製造する方法によると、補強繊維をフェノール樹脂と混合混練して成形材料とする時に、補強繊維が折れたり切れて短くなってしまうため、当初期待した通りの強度をもつ成形品を得難いという問題があった。さらに、射出成形を行なうとき、成形機のシリンダのスクリューや金型のゲートで補強繊維が切断されるため、強度の低下が大きくなるという問題があった。そして、射出成形したギヤーでは、補強繊維が配向して成形品の強度に方向性ができてしまうとか、成形を行なう際にウエルドが発生しやすく、ウエルドが発生した部分では強度が低下して割れやすい等の問題もあった。

【０００５】一方、熱硬化性樹脂を半硬化状態（Ｂステージ）としたプリプレグを所定の厚さになるように重ねて打ち抜き加工を施し、ついで、加熱加圧成形した後、歯切りしたギヤーにあっては、樹脂ワニスに例えばカーボン粉末を添加してシート状基材への含浸を行ないたいのだが、カーボン粉末が樹脂ワニスに均一に分散しないので、カーボン粉末を添加して製造することができなかった。

【０００６】また、長尺のシート状基材にフェノール樹脂ワニスを含浸乾燥し移送する工程で、シート状基材には張力がかけられており、この張力が歪みとしてプリプレグに残ったまま成形を行なっているため、成形したギヤーに反りやねじれの変形が発生しやすいという問題があった。また、強度は保持しているものの、カーボン粉末のごとき滑り剤を添加していないことから摺動性が悪いという問題があった。

【０００７】さらにまた、抄造シートを所定の厚さになるように重ねて多層シート状の成形材料とし、この成形材料を打ち抜き加工（所謂板取り加工）すると、これらの作業がまことに面倒でその作業性が悪いことに加えて、多層シート状の成形材料のロスが多く、かかる無駄をなくすために一般には再抄造する作業が必要となるという問題があった。

【０００８】そしてまた、加熱加圧成形した後に歯切りしてなるギヤーはいずれも、耐熱性や機械強度が劣ると共に線膨張係数が大きく、また吸湿性も高く寸法精度の維持が困難である等の問題があった。

【０００９】本発明はこのような実状に鑑み鋭意創案されたものであって、その目的とするところは、製造が容易で、軽量にして且つ機械強度及び耐摩耗性に優れた樹脂ギヤーとその製造方法を提供して、叙上の諸問題を解消せんとするものである。

【００１０】本発明の他の目的とするところは、内歯に相当する部分を有するプリプレグを成形し、これに加熱加圧成形処理を施すことにより、内歯樹脂ギヤーを簡単に製造でき、これを廉価に提供せんとするものである。

【００１１】

【課題を解決するための手段】そのために本発明が採用した手段の要旨とするところは、叙上の特許請求の範囲に記載の通りである。

【００１２】このような構成を採用した本発明の樹脂ギヤーによると、熱硬化性樹脂と補強繊維を含有する抄造シートを巻取ってその外周面に歯を形成したプリプレグの一部ないし全部を、金型に填めて所定形状に加熱加圧成形させることにより製造されたものであるから、前記プリプレグの連続生産が可能となり、生産性の向上が図れる。また、抄造シートを別途作成して保管し、必要に応じてこれをプリプレグへと成形することができ、最終製品たる樹脂ギヤーの生産調整が極めて容易になる。

【００１３】また、従来の、シート状基材に樹脂ワニスを含浸乾燥する場合のように、張力が働いておらず、得られた成形材料に歪みが残らないから、また、補強繊維が従来の混合混練の場合のように外力で折れることもないから、初期の繊維長をそのまま保持させることができる。すなわち、補強繊維が切断されることが原因となって、強度の低下が大きくなるとか、射出成形のように補強繊維が配向して成形品の強度に方向性ができてしまうとか、ウエルドが発生して強度が低下し割れやすいくなるとか等、従来のかかる樹脂ギヤーの具有する諸問題を解消できる。

【００１４】また、歯を構成する抄造シートの全てを当該ギヤーの半径方向に連続させた状態に配向させることができ、反りやねじれ等の変形が少なく、強度の方向性がなく、しかも精度の高い樹脂ギヤーとして提供できる。

【００１５】さらにまた、前記成形材料を打抜き加工して使用する場合とは異なり、打抜き屑が発生しないから、従来のように、打抜き屑を液中に浸漬してほぐし、再度抄造する必要がない。すなわち、成形材料を無駄なく利用できるとともにかかる面倒な作業を省けて、人件費の低減と生産性の向上が図れ、廉価に提供できる。

【００１６】特に、請求項３に記載の樹脂ギヤーよると、抄造シートに滑り剤（摺動剤、滑動剤）が主成分として含まれているため、請求項１乃至２に記載の樹脂ギヤーが具有する作用に加えて、優れた摺動性や滑動性を有する樹脂ギヤーとなる。

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【００１７】また、請求項６乃至７に記載の樹脂ギヤーよると、例えば鋼材製の芯材に抄造シートを巻く構成、或いは、合成樹脂製の芯材に、熱硬化性樹脂の種類、又は熱硬化性樹脂若しくは補強繊維の含有量が異なる抄造シートを巻く構成が採用されているから、請求項１～３のいずれかに記載の樹脂ギヤーが具有する作用に加えて、さらに、機械強度等が異なる多層構造を有した樹脂ギヤーとなる。

【００１８】つぎに、このような構成を採用した本発明の樹脂ギヤーの製造方法によると、熱硬化性樹脂と補強繊維を含有する抄造シートを巻き、最終製品たる樹脂ギヤーの歯となる部分を有するブリブレグを得、この一部ないし全部を金型に填めて加熱加圧成形するように構成されているから、従来のように、樹脂板材を成形して歯切りする所謂後工程が不要となり、かかる面倒な作業を省ける。すなわち、ブリブレグの連続生産が可能でその生産性の向上が図れるとともに、人件費の低減が図れ、しかも、精度の高い樹脂ギヤーを廉価に製造できる。

【００１９】また、抄造シートを別途作成して保管することができ、必要に応じてこれを当該ブリブレグに成形できる。すなわち、生産調整が可能となる。

【００２０】そしてまた、前記成形材料を打抜き加工して使用する場合とは異なり、打抜き屑が発生しないから、従来のように、打抜き屑を液中に浸漬してほぐし、再度抄造する必要がなくて、成形材料を無駄なく利用できる。

【００２１】さらにまた、シート状基材に樹脂ワニスを含浸乾燥する場合のように張力が働いておらず、得られた成形材料に歪みが残らない。また、補強繊維が従来の混合混練の場合のように外力で折れることがないから、初期の繊維長を殆どそのまま保たせることができる。すなわち、補強繊維が切断されるため、強度の低下が大きくなるとか、射出成形のように補強繊維が配向して成形品の強度に方向性ができてしまうとか、成形を行なう際にウエルドが発生しやすくウエルドが発生した部分での強度が低下して割れやすいとか等、従来の製造方法の具有する諸問題が解消できる。

【００２２】特に、このような構成を採用した請求項９に記載の製造方法にあっては、内歯を有する樹脂ギヤーが簡単且つ確実に製造できるという作用が得られる。

【００２３】このような構成を採用した請求項１０に記載の製造方法にあっては、叙上の樹脂ギヤーの製造方法が具有する作用に加えて、有害な有機溶媒を使用しないから、抄造シート、曳いては樹脂ギヤーを安全に製造できるという作用が得られる。

【００２４】このような構成を採用した請求項１１に記載の製造方法にあっては、抄造シートに滑り剤（摺動剤、滑動剤）が含まれているため、叙上の作用に加えて、滑動性や摺動性に優れた歯を備えた樹脂ギヤーを製造できるという作用が得られる。

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【００２５】このような構成を採用した請求項１２又は１３に記載の製造方法にあっては、例えば鋼材製の芯材に抄造シートを巻く構成、或いは、樹脂製の芯材に、樹脂の種類又は熱硬化性樹脂若しくは補強繊維の含有量が異なる抄造シートを抄造シートを巻くという構成が採用されているから、叙上の作用に加えて、特には強度等が異なる多層構造を有する樹脂ギヤーが、簡単且つ確実に製造できるという作用が得られる。

【００２６】

【発明の実施の形態】以下、本発明を具体化した実施例に基づいて詳細に説明する。

【００２７】本発明に係る方法を実施するにあたり、熱硬化性樹脂は、溶媒に分散させることができれば特に限定するものではないが、フェノール樹脂、エポキシ樹脂若しくはジアリルフタレート樹脂のごとき、水に対して分散できる熱硬化性樹脂であると、抄造シートを抄造するときに水を溶媒として使用できるから、好適である。なお、熱硬化性樹脂としてフェノール樹脂を使用する場合を例にして説明すると、その粉末の粒径は１～３０μｍが適当である。また、溶媒として有機溶媒を使用して抄造シートを抄造してもよいが、有機溶媒の安全性等に問題があるから、できる限り避けたい。

【００２８】補強繊維としては、ガラス繊維、ガラスバウダー、アラミド繊維、アラミドパルプ等が例示でき、これらの単独、或いは２種以上の混合物として使用される。

【００２９】滑り剤として例えばカーボン粉末を使用する場合には、カーボン粉末の粒径は１～５０μｍが適当であるが、抄造するときに分散させることができれば特に限定するものではない。また、カーボン粉末に代えて、カーボン繊維、ふっ素樹脂粉末、ふっ素樹脂チップのごとき他の滑り剤を使用しても構わないし、抄造に際しては、他の充填材や添加剤を適宜配合してもよい。

【００３０】図１は、第一実施例の樹脂ギヤーの製造方法を示すフローチャートであり、図２は、この製造方法で製造された樹脂ギヤーの部分平面図で、特には最終製品たる樹脂ギヤー１０の歯１１の部分における抄造シート１２の配向が模式的に示されている。

【００３１】まず、フェノール樹脂粉末（粒径１～２０μｍ）とアラミド繊維（径５～２０μｍ、繊維長２～６ｍｍ）を重量比で３５／６５の割合で水に分散させ、これを抄造して抄造シートＡとし、直ちに芯材１３の上に巻取りながら所望する所定の厚さを有する筒体１４とし、さらにこの筒体１４の上に、図３に示すように、最終製品たる樹脂ギヤー１０の歯１１となる部分に対応する所定の寸法形状に形成された押圧歯１６ａを有する押圧ローラ１６で押圧しながら前記抄造シートＡを巻き付けてブリブレグ１５を成形する。

【００３２】次に、このブリブレグ１５を所定サイズの金型内に移し、長手方向に圧力７００ｋｇ／ｃｍ²以上

で押圧した状態のまま、２００℃で１０分間、加熱加圧成形（直圧成形）を施し、ついで、室温に戻した後、カッターで切断し、さらに必要であれば表面全体を研磨して、最終製品たる樹脂ギヤー１０を得た。この樹脂ギヤー１０の特性を表１に示す。

【００３３】なお、前記筒体１４上に巻き付けする抄造シート１２が、フェノール樹脂粉末（粒径１～２０μｍ）とアラミド繊維（径５～２０μｍ、繊維長２～６ｍｍ）とカーボン粉末（粒径１～２０μｍ）を重量比で３５／５５／１０の割合で水に分散させ、これを抄造してなる抄造シートＢであると、カーボン粉末が滑り剤として機能するから、滑動性や摺動性により優れた歯を備えた樹脂ギヤーが製造できるので、好ましい。

【００３４】次に、第二実施例の樹脂ギヤー２０の製造方法は、図４にフローチャートで示すように、前記筒体１４の上に、押圧歯１６ａを有する押圧ローラ１６で押圧しつつ抄造シートＢを巻き付けるのではなく、前記抄造シートＡを巻いて成形した筒体１４の上に前記抄造シートＢを巻いて所定の筒体１４’を成形したその後に、図５に模式的に示すように、この筒体１４’の外周面を、押圧ローラ１６を回転させながらこの押圧ローラ１６に備えた押圧歯１６ａで押圧することによりブリプレグ１５を成形する点を除き、他は第一実施例の製造方法と実質的に同一の工程からなるものである。

【００３５】この第二実施例の製造方法で、第一実施例の製造方法で製造された樹脂ギヤーと同一の寸法形状を有する樹脂ギヤー２０を得た。この樹脂ギヤー２０の特性を表１に示す。

【００３６】なお、第一、第二実施例の樹脂ギヤーの製造方法において、前記筒体１４（１４’）を加熱加圧成形（直圧成形）する前に、前記ブリプレグ１５をカッター等で切断して所定厚の樹脂ギヤーブリプレグ１５’を形成し、この樹脂ギヤーブリプレグ１５’を加熱加圧成形（直圧成形）し、必要であれば表面全体を研磨して、最終製品たる樹脂ギヤーを製造しても構わない。

【００３７】このように構成された第一、第二実施例の樹脂ギヤーの製造方法によれば、抄造シート１２を直ちに巻取ってブリプレグ１５とし、その一部ないし全部が加熱加圧成形される構成であるから、このブリプレグ１５を連続的に生産でき、曳いてはかかる樹脂ギヤー生産効率の向上が図れる。

【００３８】また、シート状基材に樹脂ワニスを含浸乾燥する場合のように張力が働いておらず、得られたブリプレグに歪みが残らない。また、補強繊維は、初期の繊維長を殆どそのまま保っているから、補強繊維の切断による強度の低下が大きくなるとか、射出成形のように補強繊維が配向して成形品の強度に方向性ができてしまうとか、ウエルドが発生し易くウエルドが発生した部分の強度が低下して割れ易い等、従来の製造方法の具有する諸問題が解消できる。

【００３９】また、抄造シート１２を樹脂ギヤーの中心部を中心とする略渦巻状若しくは同心円状に配向させることができる。すなわち、例えば樹脂ギヤーに含まれる補強繊維の全てを均質に含有させることができ、反りやねじれの変形が発生し難く、また、強度の方向性や変形がなくなるとともに、ウエルドが発生し難く、ウエルドが発生した部分で強度が低下することがないから、割れ難い。

【００４０】そしてまた、前記成形材料を打抜き加工して使用する場合とは異なり、打抜き屑が発生しないから、従来のように、打抜き屑を液中に浸漬してほぐし、再度抄造する必要がない。すなわち、かかる面倒な作業を省けて人件費の低減が図れ、成形材料を無駄なく利用できるとともに生産性の向上が図れる。

【００４１】さらにまた、熱硬化性樹脂と補強繊維とカーボン粉末を主成分とする抄造シートから成形されたブリプレグを加熱加圧成形すると、硬度が高く、機械的強度に優れるとともに、摺動性や滑動性に格別優れた樹脂ギヤーが簡便かつ確実に製造できる。

【００４２】第三実施例の樹脂ギヤー３０の製造方法は、フェノール樹脂粉末（粒径１～２０μｍ）とアラミド繊維（径５～２０μｍ、繊維長２～６ｍｍ）を重量比で３５／６５の割合で水に分散させ、これを抄造して抄造シートＡとし、この抄造シートＡを乾燥して水分を除去した。尚、この乾燥は、フェノール樹脂の硬化反応が進まない温度範囲（常温）で行なった。ついで、水分を除去した抄造シートＡを、押圧ローラ１６に備えた押圧歯１６ａで押圧しながら芯材の上に巻取り、芯材を抜き取ってブリプレグ１５を得、以下は、第一実施例の製造方法と同様の後加工を施した。このようにして、上記第一実施例の製造方法で製造された樹脂ギヤー１０と同一の寸法形状を有する樹脂ギヤー３０を得た。この樹脂ギヤーの特性を表１に示す。

【００４３】第三実施例の製造方法及び該製造方法で製造された樹脂ギヤー３０の具有する作用効果は、前記第一実施例１の製造方法及び該製造方法で製造された樹脂ギヤー１０の具有する作用効果に加えて、抄造シート状を別途作成して保管し、必要に応じてこれを巻き取ってブリプレグを成形することができるため、小ロットの製造に好都合となるとともに、生産調整が極めて容易になるという優れた作用効果が得られる。

【００４４】従来例１

フェノール樹脂とガラス繊維（径９μｍ、繊維長１～２ｍｍ）を重量比で４５／５５の配合割合で混合混練し、粒状の成形材料とした。これを射出成形して第一実施例の製造方法で製造された樹脂ギヤーと同一の寸法形状を有する樹脂ギヤーを得た。この樹脂ギヤーの特性を表１に示す。

【００４５】従来例２

フェノール樹脂とアラミド繊維（径５～２０μｍ、繊維

長３ｍｍ）を重量比で４５／５５の割合で水に分散させ、これを抄造して抄造シートとし、直ちに芯材の上に巻取りながら所望する所定の厚さを有するプリプレグを成形し、ついで、このプリプレグを所定サイズの金型内に移し、長手方向に圧力７００ｋｇ／ｃｍ²以上で押圧した状態のまま、２００℃で１０分間、加熱加圧成形＊（直圧成形）を施し、室温に戻した。カッターで半径方向に切断した後に歯切り処理し、上記第一実施例の製造方法で製造された樹脂ギヤーと同一の寸法形状を有する樹脂ギヤーを得た。この樹脂ギヤーの特性を表１に示す。

【００４６】

表１

	歯元強度 (kgf)	曲げ強度 (kgf/mm²)	たわみ量 (mm/100kgf)
従来例１	137	17.0	0.28
従来例２	230	25.0	0.52
	213	24.8	0.49
	205	25.3	0.51
第一実施例	395	40.5	0.49
第二実施例	370	36.5	0.55
第三実施例	385	38.9	0.48

【００４７】ところで、上述した各実施例の樹脂ギヤーの製造方法及び該製造方法によって作成された樹脂ギヤーは、本発明の代表的な実施態様として述べたものであり、本発明は前記実施例に限定されるものではなく、本発明を実施する場合には、この発明の趣旨から逸脱しない範囲で、例えば樹脂ギヤーの全体形状、歯の寸法形状、熱硬化性樹脂や強化繊維等の種類とその配合割合等を設計変更するとか、偏芯タイプの樹脂ギヤーを製造するとか、歯の形状を平歯ではなくてハス歯に成形するとか等、適宜設計変更して実施できる。

【００４８】前記抄造シート１２を巻いて所定の筒体１４（１４’）を成形したその後に、図６に模式的に示すように、内壁面に所望する所定の寸法形状に形成された押圧歯１７ａを有する成形型１７の中に、この成形型１７若しくは筒体１４（１４’）のいずれかを所定速度で回転させながら又は両方を回転させないで強制圧入し、これにより、前記樹脂ギヤーの歯１１（外歯４１）となる部分を有するプリプレグ１５（１５’）を得、これを加熱加圧成形した後に、上述した後工程を施しても構わない。

【００４９】また、図７に模式的に示すように、前記抄造シート１２を、所望する寸法形状の押圧歯１８ａを有する成形芯１８に、押圧歯１６ａを有する押圧ローラ１６で強制押圧しながら巻いて、当該樹脂ギヤー４０の歯１１（内歯４２）なる部を有するプリプレグ４５を得、或いは、図８に模式的に示すように、抄造シート１２を巻き終えてなる中空筒体１４（１４’）の中空部１４ａの中に、外壁面に所望する所定の寸法形状に形成された押圧歯１９ａを有する成形型１９を、この成形型１９若しくは筒体１４（１４’）のいずれかを所定速度で回転させながら又は両方を回転させないで強制圧入し、これにより、当該樹脂ギヤー５０の歯１１（内歯４２）となる部分を有するプリプレグ５５を得た後、これを加熱加圧成形し、必要に応じて後加工を施すと、内歯４２を備えた樹脂ギヤー４０、５０が製造できる。この実施の態様は、特には、請求項９に記載の発明に対応するものである。

【００５０】なお、これらの製造方法において、前記成形型若しくは前記筒体のいずれかを所定速度で回転させながら強制圧入し、ついで回転させながら抜き取りされると、外歯はハス歯となる。成形型と筒体の両方を回転させずに強制圧入し、ついで回転させないでそのまま抜き取りされると、外歯は平歯となる。この実施の態様は、特には、請求項１４に記載の発明に対応するものである。

【００５１】

【発明の効果】以上述べたように、本発明になる樹脂ギヤーの製造方法はいずれも、これら樹脂ギヤーを構成する抄造シートが、当該樹脂ギヤーの略中心部を中心とする略渦巻状若しくは略同心円状に配置されるとともに、樹脂ギヤーの歯においても年輪状に抄造シートが配置されているところに構成特徴を有するものであるから、この製造方法により製造された樹脂ギヤーによると、つぎに示す優れた作用効果が得られる。

【００５２】(1) プリプレグは抄造シートの巻取りにより作られている。したがって、シート状基材に樹脂ワニスを含浸乾燥する場合のように張力が働いていないから、得られたプリプレグに歪みが残っていない。そして、このプリプレグは、補強繊維の繊維長も当所の長さを保持したままであるから、寸法精度に極めて優れる。また、補強繊維の切断による強度の低下が大きくなるとか、射出成形のように補強繊維が配向して成形品の強度に方向性ができてしまうとか、ウエルドが発生しやすくてウエルドが発生した部分では強度が低下して割れやすいとか、という従来の製造方法の具有する諸問題の全てが解消できる。

【００５３】(2) 前記抄造シートは初期の繊維長を殆どそのまま保たせたままの状態で、特には樹脂ギヤーの歯

の部分においても年輪状に配置させることができるため、プリプレグに歪みが残らないから最終製品たる樹脂ギヤーの変形が小さく、かつ、優れた強度を有する歯を備えた樹脂ギヤーが製造でき、提供できる。

【００５４】(3) つぎに、成形材料を打抜き加工して使用する従来技術とは異なり、打抜き屑が発生しないから、打抜き屑を液中に浸漬してほぐし、再度抄造する必要がない。したがって、かかる面倒な作業を省け、人件費の低減が図れるとともに、生産性の向上が図れるから、樹脂ギヤーの製造コストの低減が図れ、これを廉価に提供できる。

【００５５】(4) 前記抄造シートが、熱硬化性樹脂と補強繊維とを主成分として抄造されている場合には、硬度が高く、機械的強度に優れた樹脂ギヤーを、簡便かつ確実に製造でき、提供できる。そして、前記抄造シートが、熱硬化性樹脂と補強繊維とカーボン粉末のごとき滑り剤とを主成分として抄造されて、樹脂ギヤーの歯を構成する部分に使用されている場合には、滑り剤が含まれているので、摺動性と滑動性に優れた樹脂ギヤーを簡便且つ確実に製造でき、提供できる。

【００５６】(5) 特に、請求項９に記載の樹脂ギヤーの製造方法によると、今まで簡単には成形できなかった「内歯となる部分を有するプリプレグ」を簡単且つ確実に成形できて「内歯樹脂ギヤー」へと加熱加圧成形することができる。すなわち、内歯が平歯であるとかハス歯であるとかには関係なく、これらを確実に製造できて、廉価に提供できる。

【図面の簡単な説明】

【図１】　図１は、第一実施例の樹脂ギヤーの製造方法を概略的に示すフローチャートである。

【図２】　図２は、本発明になる一樹脂ギヤーの部分平面図であり、特には、外歯の周辺部における抄造シートの配向が模式的に示されている。

【図３】　図３は、最終製品たる樹脂ギヤーの歯となる部分に対応する所定の寸法形状に形成された押圧歯を有する押圧ギヤーで押圧しながら（白抜き矢印）抄造シートを巻いている様子を模式的に示す斜視図である。

【図４】　図４は、第二実施例の樹脂ギヤーの製造方法を概略的に示すフローチャートである。

【図５】　図５は、押圧歯を有する押圧ギヤーを回転させながらこの押圧歯で筒体の外周面を押圧してプリプレグを成形している様子を模式的に示す斜視図である。

＊【図６】　図６は、抄造シートを巻いてなる筒体を、内壁面に所望する所定の寸法形状に形成された押圧歯を有する成形型の中に強制圧入し、これにより、前記樹脂ギヤーの外歯となる部分を有するプリプレグを成形している様子を説明するために模式的に示す正面図である。但し、成形型のみが断面図で示されている。

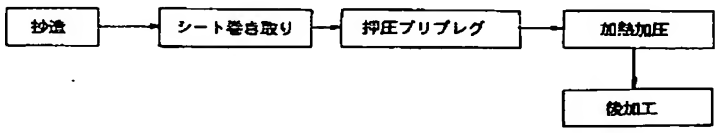
【図７】　図７は、押圧歯を有する成形芯に押圧ローラで抄造シートを押圧しながら巻いて当該樹脂ギヤーの内歯となる部分を有するプリプレグを成形している様子を説明するために模式的に示す一部破断斜視図である。

【図８】　図８は、抄造シートを巻き終えてなる中空の筒体の中に、外壁面に押圧歯を有する成形型を強制圧入して、当該樹脂ギヤーの内歯となる部分を有するプリプレグを成形している様子を説明するために模式的に示す正面図である。但し、成形型の枠体部分は断面図で示されている。

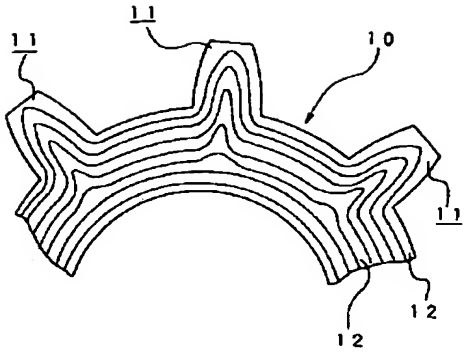
【符号の説明】

１０…樹脂ギヤー
１１…歯
１２…抄造シート
１３…芯材
１４…筒体
１４’…筒体
１４ａ…中空部
１５…プリプレグ
１５’…樹脂ギヤープリプレグ
１６…押圧ローラ
１６ａ…押圧歯
１７…成形型
１７ａ…押圧歯
１８…成形芯
１８ａ…押圧歯
１９…成形型
１９ａ…押圧歯
２０…樹脂ギヤー
３０…樹脂ギヤー
４０…樹脂ギヤー
４１…外歯
４２…内歯
４５…プリプレグ
５０…樹脂ギヤー
５５…プリプレグ

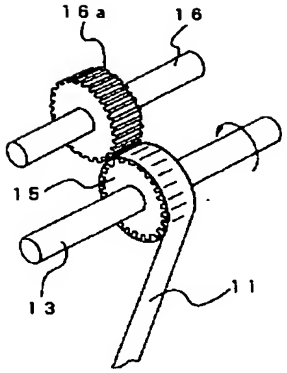
【図１】



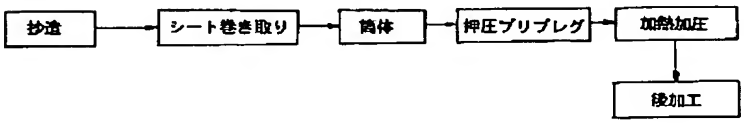
【図２】



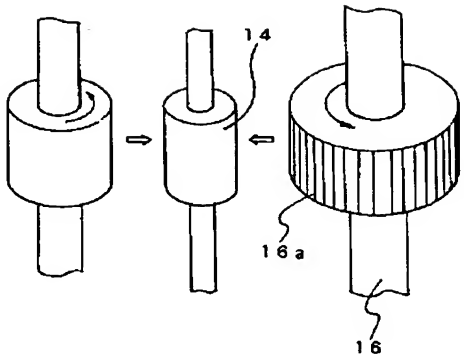
【図３】



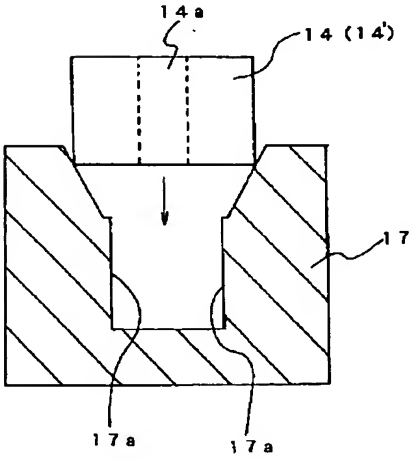
【図４】



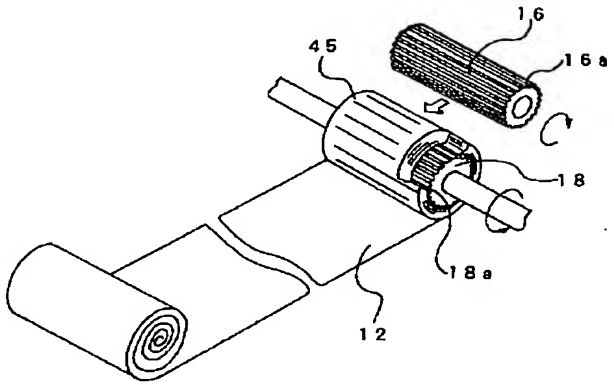
【図５】



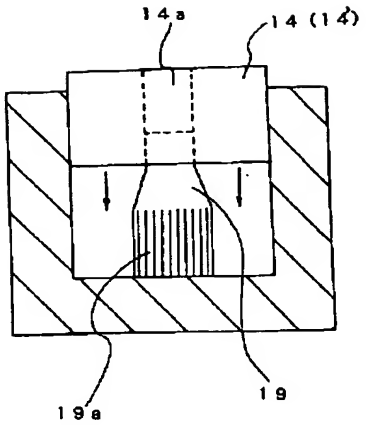
【図６】



【図７】



【図８】



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